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CURRENT LITERATURE.

BOOK REVIEWS.

Plant response.

No subject is more fascinating than the responses of plants to stimuli; and though the mechanisms involved are often much simpler than in the case of animals, no subject is more difficult. Papers dealing with limited topics in this field are constantly appearing; one feels some surprise at seeing a large volume of new researches dealing with the matter in the most fundamental fashion. The surprise is increased when it is seen that the author is one whose name is new in the literature of plant physiology and whose nation is fond rather of speculative philosophy than of scientific observation. Professor Jagadis Chunder Bose of Presidency College, Calcutta, published in 1902 a volume on *Response in the living and non-living*, in which he pointed out many parallels between the "irritability" of organisms and of other bodies. But this volume seems not to have attracted general attention among physiologists; and some of those who read it were inclined to discount the parallelism as one suggested rather by philosophic bias than scientific induction.

On opening this new work[1] the plant physiologist will be inclined to think it some volume on muscle-response in animals, the numerous graphs being quite like those made familiar by the usual records from muscle-nerve apparatus. Closer inspection, however, shows that the author, trained in a laboratory for animal physiology and in the methods of research in vogue for pulse and muscle, has applied these methods to detecting before unsuspected (or at least unrecorded) responses in plants.

But he has done much more than merely apply the existing apparatus and methods. He has employed new methods and has devised new and ingenious apparatus for automatically recording responses. For example, there are described many clever minor adaptations of the optic lever and various electric devices; and among the major ones may be enumerated the kunchangraph (Sanskrit: *kunchan* = contraction) for recording longitudinal contraction in radial organs on applying electric, thermic, or chemic stimuli; the morograph, for recording the death spasm of the contractile protoplasm, and the comparison morograph for recording the response of two plants simultaneously while under different conditions; the shoshungraph (Sanskrit: *shoshun* = suction) for recording the rate of transpiratory suction and its variations; the crescograph, balanced so as to record the average rate of growth as a straight horizontal line, any fluctuation, even the slightest, showing as deviation from this horizontal line; and the magnetically controlled heliotropic recorder, utilizing the optic lever yet avoiding the use of light within the plant chamber, except that which is the stimulus.

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[1] Bose, J. G., Plant response as a means of physiological investigation. 8vo. pp. 781. *figs. 278.* London, New York, and Bombay: Longmans, Green, & Co. 1906.

One striking feature of all the apparatus, aside from its ingenuity, is the high magnification which it permits. This is at once an advantage and a danger; but consistent results, if critically controlled, ought to guard against serious error.

The book is not without errors, both of reasoning and fact, into which the author has fallen by reason of some unfamiliarity with his materials. No one could justify himself in accepting as established all the deductions from the vast number of experiments detailed in the book; they must be verified sooner or later by other observers. To our knowledge some have already been repeated (some of those, for instance, on the variation in electric potential resulting from stimulation, in Dr. HARPER'S laboratory at the University of Wisconsin) with concordant results. But whatever the future may show as to the accuracy of details, this book may be acclaimed as a path-breaking one; for it shows a method of attack and a refinement of instrumentation for the study of the phenomena of irritable reactions in plants that are sure to be of the utmost service. It is rather remarkable, indeed, that we have had so few recording instruments in the service of plant physiology, and that we have been content, for example, with magnifications of 10 or 20 times in the auxanometer, where BOSE finds 1,000 or even 10,000 practicable with his crescograph.

The fundamental thesis of the book is that the underlying response to stimuli is alike in plants and animals; is alike in all plants and in all parts, with all stimuli; and is universal. This response, however diverse its modes of expression, consists of two very simple and well-defined factors, contraction and expansion; the former the direct effect of stimulation, the latter the indirect. Mechanical response is always by a concavity of the more excited side and may or may not occur; electrical response can always be detected; growth is merely a multiple response; at death (near 60° C. for phanerogams) a sudden and irreversible molecular change takes place, attended by an excitatory contraction. The phenomena of fatigue, of staircase response when the organ is at first sluggish, of tetanus, of the polar effects of electric currents, of variation in electric potential, of transmission of stimuli, and of rhythmic responses—all can be demonstrated in plants as in animals, giving evidence in greater detail of the essential unity. With this BOSE is more impressed and on it he lays more stress than the case demands; for it is by no means so novel an idea to botanists as to most zoologists.

Of all the fifty chapters in the book none are so unsatisfactory as those on the ascent of sap, constituting part V. BOSE holds that he has demonstrated the ascent of water to be due to the physiological activity of living cells whose suctional response is coordinated by the passage from point to point of an excitatory reaction which drives water in one direction.[2] But some of his reasoning is radically defective, the chapters are full of assumptions, and his experiments are inconclusive. Indeed, he hardly seems to know how difficult a problem he is attacking, and he goes at it with the naïveté of a novice. Such work really tends to prejudice one against the whole book; and caution *is* necessary, for there are other weak spots. In spite of these, the suggestiveness, the ingenuity, and the enormous labor displayed impel us to give this book a most cordial reception. And we shall await with much interest a promised volume on the electrophysiology of plants.—C. R. B.

MINOR NOTICES.

N. Am. Uredineae.—The second part of HOLWAY'S photomicrographs of plant rusts[3] has just appeared, having been delayed several months by a printer's strike. The general character and purpose of this publication were described in this journal[4] upon the appearance of the first part. The present part continues the genus Puccinia through eleven host families, ending with Rosaceae. The photogravure plates carry out fully the promise of the first part.—J. M. C.

Schneider's Handbuch.—The fifth part of the *Illustriertes Handbuch der Laubholzkunde*[5] concludes Drupaceae and includes Pomaceae, and ends the first volume. There are 128 text figures, and a volume index of genera.—J. M. C.

NOTES FOR STUDENTS.

The ascent of water.—After GODLEWSKI'S interesting theory of the relay-pump action of the medullary rays in lifting water seemed to have been completely overthrown by STRASBURGER,[6] who found water still ascending for weeks after treatment calculated to kill living cells, the participation of living cells in lifting water found a champion on theoretical grounds in SCHWENDENER.[7] But PFEFFER[8] hardly dared more than to suggest that they might be of importance in

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[2] See in this connection reviews of other recent papers below.

[3] HOLWAY, E. W. D., North American Uredineae, Vol. I. part II. 4to. pp. 33–56. *pls. 11–23.* Minneapolis, 1906. $2.00.

[4] BOT. GAZETTE 40:459. 1905.

[5] SCHNEIDER, CAMILLO KARL, Illustriertes Handbuch der Laubholzkunde. Fünfte Lieferung. Jena: Gustav Fischer. 1906. *M* 4.

[6] STRASBURGER, E., Ueber den Bau und die Verrichtungen der Leitungsbahnen in den Pflanzen. Histologische Beiträge 3. Jena, 1891. Ueber das Saftsteigen. Histologische Beiträge 5. Jena, 1893.

[7] SCHWENDENER, S., Zur Kritik der neuesten Untersuchungen über das Saftsteigen. Sitzb. Berliner Akad. 44:911–946. 1892. Gesammelte Unters. 1:256–297. Weitere Ausführungen über die durch Saugung bewirkte Wasserbewegung in der Jamin'schen Ketten. Sitzb. Berliner Akad. 45:835–846. 1893. Gesammelte Unters. 1:298–315. 1898.

[8] PFEFFER, W., Pflanzenphysiologie 1:203. 1897.